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Proposed Best Demonstrated Available Technology (BDAT) Background Document for Wastewater Treatment Sludges Generated in the Production of Creosote K035. Volume 13

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This background document provides the Agency's rationale and technical support for selecting the constituents for proposed regulation in K035 and for developing treatment standards for these constituents. The document also provides waste characterization data that serve as a basis for determining whether a variance from a treatment standard may be warranted for a particular type of K035 that is more difficult to treat than the wastes that were analyzed in developing treatment standards for K035.

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PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT

FOR WASTEWATER TREATMENT SLUDGES GENERATED IN

THE PRODUCTION OF CREOSOTE

K035

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Note: This proposed Background Document is being issued in support of the Agency's proposed rulemaking for the land disposal restrictions program. The Agency solicits comments on the proposed rule and on this proposed Background Document. This document will be issued in final form, appropriately revised in response to comments, at the time of promulgation of the final rule.

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA or Agency) is proposing to establish best demonstrated available technology (BDAT) treatment standards for the listed hazardous waste identified in Title 40, Code of Federal Regulations, Section 261.32 (40 CFR 261.32) as K035, wastewater treatment sludges generated in the production of creosote. These BDAT treatment standards are being established in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984. BDAT treatment standards will be effective no later than May 8, 1990, and on and after the effective date, compliance with these BDAT treatment standards will be a prerequisite under 40 CFR Part 268 for placement of the waste in land disposal units.

This background document provides the Agency's rationale and technical support for selecting the constituents for proposed regulation in K035 and for developing treatment standards for these constituents. The document also provides waste characterization data that serve as a basis for determining whether a variance from a treatment standard may be warranted for a particular type of K035 that is more difficult to treat than the wastes that were analyzed in developing treatment standards for K035.

The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting

a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).

This background document presents waste-specific information on the number and locations of facilities that may be affected by the land disposal restrictions for K035, the processes generating this waste, the waste characterization data, the technologies used to treat the waste (or similar wastes, if any), and the treatment performance data on which the proposed treatment standards are based (Sections 2.0 - 4.0). This document also explains how EPA determines BDAT, selects constituents to be regulated, and calculates treatment standards (Sections 5.0 - 7.0).

Under 40 CFR 261.32, wastes identified as K035 are listed as follows:

K035 - Wastewater treatment sludges generated in the production of creosote.

The four-digit Standard Industrial Classification (SIC) code associated with the production of creosote is 2865. The Agency estimates that there are eight domestic facilities that may generate K035.

The Agency is proposing twelve organic constituents for regulation in K035 nonwastewater and nine organic constituents for regulation in K035 wastewater. To determine the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1% (weight basis) total

suspended solids[1] (TSS) and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with nonwastewater treatment standards.

The Agency does not have any performance data for treatment of K035. Treatment performance tests for this waste have not been pursued because the Agency believes that adequate treatment performance data are available from similar wastes previously tested by the BDAT Land Disposal Restrictions Program. Therefore, treatment performance data were transferred to K035 from another previously tested waste.

For nonwastewater and wastewater forms of K035, proposed BDAT treatment standards are based on treatment performance data transferred from incineration of K087.

The tables at the end of this section list the proposed BDAT treatment standards for nonwastewater and wastewater forms of K035. These proposed treatment standards are based on the total concentration of each constituent in the waste. The units used for total constituent concentration of organic

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[1]The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, total suspended solids is measured by Method 209C (total suspended solids dried at 103-105°C) in Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition (Reference 2).

constituents are mg/kg (parts per million on a weight-by-weight basis) for K035 nonwastewaters, and mg/l (parts per million on a weight-by-volume basis) for K035 wastewaters. If the concentrations of the constituents proposed for regulation in K035 nonwastewaters and wastewaters, as generated, are lower than or equal to the proposed treatment standards, then treatment of the waste would not be required prior to "land disposal," as defined by 40 CFR Part 268.

Table 1-1

PROPOSED BDAT TREATMENT STANDARDS FOR K035

NONWASTEWATERS

	Maximum for Any Single Grab Sample
BDAT List Constituent	Total Concentration (mg/kg)
52. Acenaphthene	3.4
57. Anthracene	3.4
59. Benz(a)anthracene	3.4
62. Benzo(a)pyrene	3.4
80. Chrysene	3.4
83. Dibenz(a,h)anthracene	3.4
108. Fluoranthene	3.4
109. Fluorene	3.4
116. Indeno(1,2,3-cd)pyrene	3.4
121. Naphthalene	3.4
141. Phenanthrene	3.4
145. Pyrene	8.2

Table 1-2

PROPOSED BDAT TREATMENT STANDARDS FOR K035

WASTEWATERS

Maximum for Any Single Grab Sample	
BDAT List Constituent	Total Concentration (mg/l)
59. Benz(a)anthracene	0.028
80. Chrysene	0.14
81. o-Cresol	0.028
82. p-Cresol	0.028
108. Fluoranthene	0.028
121. Naphthalene	0.028
141. Phenanthrene	0.028
142. Phenol	0.031
145. Pyrene	0.056

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industries that may be affected by the land disposal restrictions for K035, the processes generating the waste, and available waste characterization data. All tables and figures are presented at the end of this section.

2.1 Industry Affected and Process Description

Under to CFR Part 261.32, K035 is defined as wastewater treatment sludges generated in the production of creosote. The Agency estimates that there are approximately eight potential generators of this waste. Table 2-1 lists the potential generators by location and EPA region.

Creosote is produced by the distillation of coal tar. (Coal tar is a product of the high-temperature carbonization of bituminous coal.) A generic process diagram is shown in Figure 2-1. During the distillation of coal tar, water is boiled off and then condensed. The condensed water is typically sent to an oil/water separator, with the water fraction going to a wastewater treatment unit and the oil and sludge commonly recycled. The wastewaters are commonly treated by solar evaporation or by biological treatment or aeration followed by clarification. Sludge from the wastewater treatment unit is the listed waste stream of concern, K035.

2.2 Waste Characterization

Available data sources (References 3 and 4) indicate the following general composition for K035:

Constituent	Concentration (%)
Volatile organics	1.5
Naphthalene	15
Semivolatile organics (other than naphthalene)	28.5
Water	50
Other	5
Total:	100%

Specific waste characterization data are presented in Table 2-2. These data are for K035 samples that were collected by EPA in April and May, 1989 and represent three forms of K035:

- bottom oil layer from oil/water separation of creosote manufacturing wastewater (K035-1);
- sludge from a clarifier downstream from oil/water separation and biological treatment of creosote manufacturing wastewater (K035-2); and
- sludge from solar evaporation of creosote manufacturing wastewater, i.e., the bottom layer from the evaporation tank.

Table 2-1

FACILITIES THAT MAY GENERATE K035, BY LOCATION AND EPA REGION

Facility/Location	EPA Region
Aristech Chemical Corp.	
Clairton, PA	III
Koppers Company Inc.	
Cicero, IL	V
Dolomite, AL	IV
Follansbee, WV	III
Houston, TX	VI
Portland, OR	X
Reilly Industries	
Granite City, IL	V
Provo, UT	V

Source: See References 3 and 4.

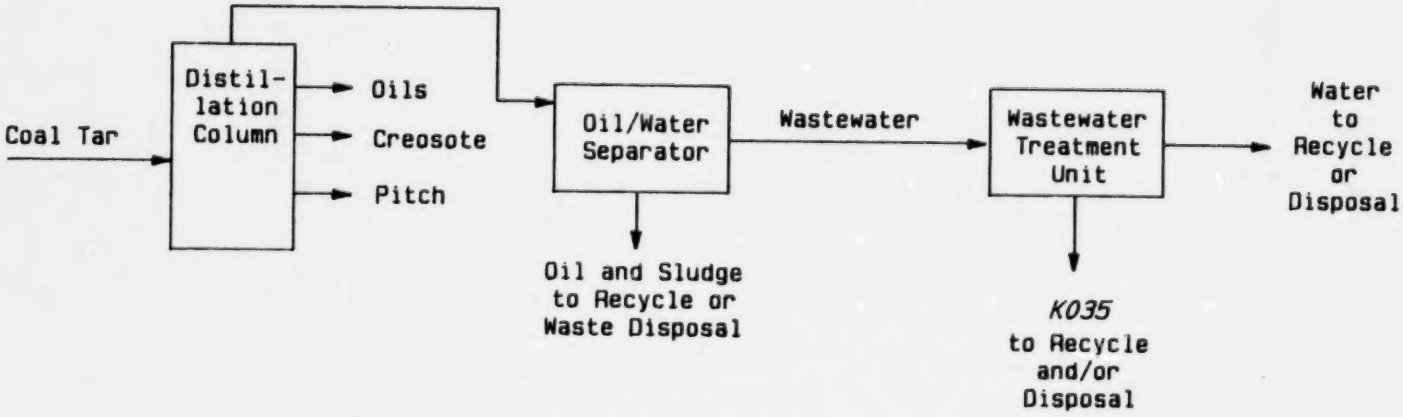

Figure 2-1. Flow Diagram for Wastewater Treatment During the Production of Creosote

Table 2-2

K035 CHARACTERIZATION DATA

BDAT List Constituent	Concentration in Untreated Waste (ppm) K035-1	K035-2	K035-3
Volatiles			
4. Benzene	3,700	ND	4.5
8. Carbon disulfide	ND	0.053	ND
226. Ethylbenzene	1,100	0.027	ND
228. Methanol (methyl alcohol)	9.7	ND	ND
38. Methylene chloride	ND	0.026	ND
39. Pyridine	610	ND	ND
43. Toluene	8,700	0.35	9.3
215-217. Total Xylenes	2,000	0.018	3.2
Semivolatiles			
51. Acenaphthalene	7,600	ND	9
52. Acenaphthene	18,000	ND	32
57. Anthracene	10,000	ND	38
59. Benzo(a)anthracene	5,400	ND	19
60. Benzenethiol	ND	ND	19
62. Benzo(a)pyrene	2,400	7.6	6
63. Benzo(b)fluoranthene	2,300	7.4	7
64. Benzo(ghi)perylene	1,100	3.6	ND
65. Benzo(k)fluoranthene	1,700	4.5	7
80. Chrysene	5,800	ND	22
81. ortho-cresol (2-methylphenol)	3,300	ND	31
82. para-cresol (4-methylphenol)	4,100	19	160
83. Dibenz(a,h)anthracene	2,600	ND	ND
96. 2-4-Dimethylphenol	2,600	ND	7

Note: K035-1 represents an oil/water separator bottom oil layer, K035-2 represents an oil/water separation and biological treatment clarifier sludge, and K035-3 represents an evaporator tank bottom layer. All three of these samples are the listed waste K035.

ND - Not detected.

Table 2-2 (Continued)

K035 CHARACTERIZATION DATA

BDAT List Constituent	Concentration in Untreated Waste (ppm) K035-1	K035-2	K035-3
108. Fluoranthene	21,000	ND	76
109. Fluorene	17,000	ND	43
116. Indeno(1,2,3-cd)pyrene	1,100	4.6	ND
121. Naphthalene	220,000	ND	370
141. Phenanthrene	50,000	ND	150
142. Phenol	4,000	ND	510
145. Pyrene	19,000	ND	64
146. Resourcinol	ND	ND	21
Metals			
155. Arsenic	1.61	0.44	4.4
156. Barium	0.2	5.19	108
157. Beryllium	ND	ND	0.2
158. Cadmium	1.22	1.59	3.77
159. Chromium (total)	ND	2.11	20.8
221. Chromium (hexavalent)	0.6	ND	0.28
160. Copper	ND	1.98	315
161. Lead	1.32	0.49	47
162. Mercury	ND	2.87	134
163. Nickel	ND	ND	516
164. Selenium	0.61	1.74	ND
166. Thallium	0.21	0.13	0.55
167. Vanadium	ND	1.55	9.92
168. Zinc	3.35	3.22	61.6
Inorganics			
169. Cyanide	ND	23.7	1,080
170. Fluoride	2.42	80.1	ND
171. Sulfide	46	43	291

Note: K035-1 represents an oil/water separator bottom oil layer, K035-2 represents an oil/water separation and biological treatment clarifier sludge, and K035-3 represents an evaporator tank bottom layer. All three of these samples are the listed waste K035.

ND - Not detected.

3.0 APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section discusses the technologies that are applicable to treatment of K035 nonwastewaters and wastewaters and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must theoretically be usable to treat the waste in question or a waste that is similar in terms of parameters that affect treatment selection. (Detailed descriptions of technologies that are applicable to listed hazardous wastes are provided in EPA's Treatment Technology Background Document (Reference 5). To be demonstrated, a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Technologies available only at pilot or bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

The following subsections present applicable treatment technologies for nonwastewater and wastewater forms of K035.

Nonwastewaters

Since nonwastewater forms of K035 consist primarily of organic compounds (as shown in Section 2.0 of this document), applicable treatment

technologies include those that destroy or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as potentially applicable for these wastes: (1) incineration (fluidized bed and rotary kiln); (2) solvent extraction followed by incineration or recycle of the extract; and (3) critical fluid extraction followed by recycle or incineration of the contaminated solvents. Total recycle or reuse has also been identified as an applicable treatment technology for K035 nonwastewaters. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Incineration. Incineration is a destruction technology in which energy, in the form of heat, is transferred to the waste to destabilize chemical bonds and destroy organic constituents. In a fluidized bed incinerator, waste is injected into the fluidized bed material (generally sand and/or incinerator ash), where it is heated to its ignition temperature. Heat energy from the combustion reactions is then transferred back to the fluidized bed. Ash is removed periodically during operation and during bed change-outs.

In a rotary kiln incinerator, wastes are fed into the elevated end of the kiln, and the rotation of the kiln mixes the waste with hot gases to heat the waste to its ignition temperature. Ash is removed from the lower end of the kiln. Combustion gases from the kiln enter the afterburner for complete destruction of organic waste constituents. Other wastes may also be injected into the afterburner.

Combustion gases from the fluidized bed or kiln afterburner are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, two residuals are generated by incineration processes: ash and scrubber water.

Solvent Extraction. Solvent extraction is a separation technology in which organics are removed from the waste due to greater constituent solubility in the solvent phase than in the waste phase. This technology results in the generation of two treatment residuals: a treated waste residual and an extract. The extract may be recycled or further treated by incineration.

Critical Fluid Extraction. Critical fluid extraction is a solvent extraction technology in which the solvent is brought to its critical state to aid in the extraction of organic constituents from the wastes. After the extraction step, the solvent (liquefied gas at its critical state) is brought to its normal condition in the gaseous state and generates a small volume of extract that is concentrated in organic constituents. This technology results in the generation of two treatment residuals: a treated waste and an extract. The extract may be recycled or further treated by incineration.

Total Recycle or Reuse. Total recycle or reuse of a waste in the same process or another process eliminates the generation of the waste and generates no treatment residuals.

Wastewaters

Since wastewater forms of K035 may contain organic constituents at treatable concentrations, applicable technologies include those that destroy or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as potentially applicable for treatment of K035 wastewaters: (1) incineration; (2) steam stripping; (3) biological treatment; (4) carbon adsorption; and (5) solvent extraction. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Incineration. Incineration of wastewaters in a rotary kiln or fluidized bed is identical to that for nonwastewaters described previously in this section. In addition, liquid injection incineration may also be applicable to K035 wastewaters.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator. Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, only wastes with low or negligible ash content are amenable to liquid injection incineration. Therefore, this technology generally does not result in the generation of an ash residual.

Steam Stripping. Steam stripping is a separation technology in which organics are removed from the waste by volatilization through the

application of heat. This technology results in the formation of two treatment residuals: a treated waste extract and a treated effluent. The treated waste extract and the treated effluent may require further treatment by incineration, and carbon adsorption or biological treatment, respectively.

Biological Treatment. Biological treatment is a destruction technology in which organic constituents in wastewaters are biodegraded. This technology results in the formation of two treatment residuals: a treated effluent and a waste biosludge. The treated effluent and the waste biosludge may require further treatment for metals by chemical precipitation and stabilization, respectively.

Carbon Adsorption. Carbon adsorption is a separation technology in which organic constituents in wastewaters are selectively absorbed onto activated carbon. This technology results in the formation of two treatment residuals: a treated effluent and spend activated carbon. The treated effluent may require further treatment for metals by chemical precipitation. The spend carbon may require further treatment by incineration.

Solvent Extraction. Solvent extraction of wastewaters is identical to that for nonwastewaters described previously in this subsection.

3.2 Demonstrated Treatment Technologies

The Agency is aware of one facility that treats K035 by biological treatment after mixing it with other wastes generated at the facility.

Therefore, biological treatment is a demonstrated technology for K035. The Agency is aware of two facilities that recycle K035 nonwastewaters. Total recycle is therefore demonstrated for K035 nonwastewaters. However, EPA does not believe that these technologies may be applicable to all forms of K035. Organic wastes, including wastes judged to be similar to K035, are commonly incinerated by industry. Because incineration is demonstrated for wastes judged to be similar to K035, incineration is considered to be demonstrated for K035. The Agency is not aware of any other technologies that are demonstrated for treatment of K035.

4.0 TREATMENT PERFORMANCE DATA BASE

This section presents the treatment performance data that were used to develop proposed treatment standards for nonwastewater and wastewater forms of K035.

Where data are not available on the treatment of the specific waste of concern, the Agency may elect to transfer performance data from a demonstrated technology that treats a similar waste or wastes. EPA's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1). Transfer of treatment performance data is technically valid in cases where the untested wastes are generated from similar industries or similar processing steps, or have similar waste characteristics affecting treatment selection and performance that are similar to those of the tested wastes.

The Agency does not have any treatment performance data for treatment of K035 nonwastewaters or wastewaters. However, treatment performance data were available from other wastes previously tested by EPA and were transferred to develop proposed treatment standards for K035. Sources of treatment performance data for potential transfer to K035 include wastes previously tested by incineration (including rotary kiln, fluidized bed, and liquid injection). These technologies were identified as applicable and demonstrated for treatment of these wastes, as discussed in Section 3.0 of this document.

Previous incineration tests conducted by the Agency are listed in Table 4-1 at the end of this section. EPA examined the wastes incinerated in these tests to identify the best data source(s), if any, for transfer of treatment performance data to K035 nonwastewaters. Specifically, EPA examined (1) whether the untested K035 is generated from a similar industry or processing step and (2) whether the waste has similar waste characteristics affecting treatment performance as do those previously tested wastes.

Although they are not generated by the same industry as K035, wastes included in Tests 1, 2, and 8 are generated in the form of sludges from separation technologies, as is K035. Wastes included in Tests 2 and 8 are also generated during the production or use of coke by-products, like K035.

As discussed in the Treatment Technology Background Document (Reference 5), waste characteristics that affect treatment performance for incineration include the thermal conductivity of the waste and the boiling points and bond dissociation energies of the constituents of concern. Of the three tests mentioned above, the waste incinerated in Test 8, K087, had the most constituents in common with or similar to K035. The wastes incinerated in Tests 1 and 2 had 5 constituents in common with K035, while the waste incinerated in Test 8, K087, had 12 constituents in common with K035. The constituents detected in K035 have the same or similar boiling points and bond dissociation energies as those in K087. Since these constituents were at the same or higher concentrations in K087, it is expected that K087 will have similar

physical properties to K035, and K035 will therefore show comparable treatment performance results.

Based on the similarities discussed above, treatment standards for constituents being proposed for regulation in K035 nonwastewaters were developed based on treatment performance data transferred from rotary kiln incineration of K087 in Test 8.

Table 4-2 presents the BDAT List constituents detected in the untreated K087 collected by EPA from the rotary kiln incineration treatment test of K087. Table 4-3 presents the BDAT List constituents detected in the kiln ash residual, and Table 4-4 presents the BDAT List constituents detected in the scrubber water residual. Design and operating data for the rotary kiln and secondary combustor are presented in Table 4-5. Additional details of this test may be found in the Onsite Engineering Report for K087 (Reference 6).

Table 4-1

WASTES TESTED BY INCINERATION AND SAMPLED BY EPA

Test Number	Waste Code(s)	Treatment Technology Used
1	K001 - Pentachlorophenol waste	Rotary kiln incineration
2	K001 - Creosote waste	Rotary kiln incineration
3	K011, K013, K014	Rotary kiln incineration
4	K019	Rotary kiln incineration
5	K024	Rotary kiln incineration
6	K037	Rotary kiln incineration
7	K048, K051	Fluidized bed incineration
8	K087	Rotary kiln incineration
9	K101	Rotary kiln incineration
10	K102	Rotary kiln incineration
11	F024	Rotary kiln incineration
12	K015	Liquid injection incineration
13	D014, D016, P059*, U127*, and U192*	Rotary kiln incineration
14	U141*, U028*, P020*, U112*, U226*, U239*, U080*, U220*, U166*, U161*, and U188*	Rotary kiln incineration

*Commercial chemical products were used in these test burns as surrogates for these wastes.

Table 4-2

ANALYTICAL RESULTS FOR UNTREATED K087
COLLECTED PRIOR TO TREATMENT BY ROTARY KILN INCINERATION

Constituent/parameter (units)	Concentration				
	Sample Set #				
	1	2	3	4	5
BDAT Volatile Organics (mg/kg)					
Benzene	17	19	5.6	212	170
Methyl ethyl ketone	<2.0	<2.1	<2.0	<10	<10
Toluene	17	17	5.0	152	130
Xylenes	21	23	3.0	123	121
BDAT Semivolatile Organics (mg/kg)					
Acenaphthalene	11000	12000	10000	13000	10000
Anthracene	7500	8100	7100	8100	6700
Benz(a)anthracene	5700	5900	5600	7500	5400
Benzo(b)fluoranthene	3200	<1010	3100	<982	5300
Benzo(k)fluoranthene	3100	7500	3100	9300	<1026
Benzo(a)pyrene	4100	4300	4100	5400	3800
Chrysene	5100	5300	5100	6500	4700
para-Cresol	1600	1600	1300	1900	1200
Fluoranthene	11000	12000	11000	<982	11000
Fluorene	7600	7900	7000	9300	7000
Indeno(1,2,3-cd)pyrene	2100	2500	2300	3100	2100
Naphthalene	64000	66000	64000	81000	63000
Phenanthrene	34000	34000	15000	41000	15000
Phenol	1600	1500	1200	1800	1200
Pyrene	9100	5900	8000	9700	8100
BDAT Metals (mg/kg)[a]					
Antimony	<2.0	<2.0	<2.0	<2.0	<2.0
Arsenic	6.1	6.1	5.5	1.9	5.2
Barium	<20	<20	<20	<20	<20
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	1.7	2.1	2.1	1.7	1.9
Chromium	<2.0	<2.0	<2.0	<2.0	<2.0
Copper	3.2	4.5	3.2	<2.5	2.6
Lead	85	80	72	64	69
Mercury	2.9	3.6	3.8	4.2	3.3
Nickel	<4.0	4.6	<4.0	<4.0	<4.0
Selenium	1.2	1.6	1.3	1.4	1.2
Silver	<5.0	<5.0	<5.0	<5.0	<5.0
Thallium	2.7	2.3	2.2	2.1	2.2
Vanadium	<5.0	<5.0	<5.0	<5.0	<5.0
Zinc	63	63	58	50	66

Table 4-2 (Continued)

ANALYTICAL RESULTS FOR UNTREATED K087
COLLECTED PRIOR TO TREATMENT BY ROTARY KILN INCINERATION

Constituent/parameter (units)	Concentration				
	Sample Set #				
	1	2	3	4	5
BDAT Inorganics Other Than Metals (mg/kg)					
Cyanide	22.8	18.2	21.1	22.0	17.9
Fluoride	0.38	-	-	-	0.18
Sulfide	323	320	275	293	302
Non-BDAT Volatile Organics (mg/kg)					
Styrene	12	12	3.4	26	71
Non-BDAT Semivolatile Organics (mg/kg)					
Dibenzofuran	5300	5600	5200	6800	5000
2-Methylnaphthalene	7000	6900	6300	9400	6200
Other Parameters					
Ash content (%)	2.9	3.4	9.7	3.7	2.7
Heating value (Btu/lb)	15095	14898	14823	15336	14959
Percent water (%)	5.70	10.31	11.26	7.72	6.60
Total halogens as chlorine (%)	0.033	0.023	0.026	0.045	0.057
Total organic carbon (%)	83.67	76.38	84.27	79.10	85.57
Total organic halides (mg/kg)	27.0	28.0	29.3	87.7	25.8
Total solids (%)[b]	87.7	90.5	91.1	89.7	86.5
Viscosity[c]	-	-	-	-	-
Elemental constituents (%)					
Carbon	83.80	81.90	84.01	66.36	77.54
Hydrogen	5.62	5.14	5.27	6.46	5.97
Nitrogen	1.13	1.06	1.03	0.82	0.96
Oxygen	9.13	11.94	10.25	26.59	15.71

- = Not analyzed.
ND = Not detected; estimated detection limit has not been determined.

Note: This table shows concentrations or maximum potential concentrations in the untreated waste for all constituents detected in the untreated waste.

[a]Results have been reported on a wet weight basis.
[b]Total solids results are biased low because of test complications arising from waste matrix.
[c]Because of the high concentration of solids in the waste, viscosity values could not be determined.

Source: BDAT Background Document for K087 (Reference 7).

Table 4-3

ANALYTICAL RESULTS FOR KILN ASH GENERATED BY ROTARY KILN INCINERATION OF K087

Constituent/parameter (units)	Concentration				
	Sample Set #				
	1	2	3	4	5
BDAT Volatile Organics (µg/kg)					
Benzene	<25	<25	<25	<25	<25
Methyl ethyl ketone	<25	<25	<25	<25	<25
Toluene	150	85	<25	<25	190
Xylenes	<25	<25	<25	<25	<25
BDAT Semivolatile Organics (µg/kg)					
Acenaphthalene	<1000	<1000	<1000	<1000	<1000
Anthracene	<1000	<1000	<1000	<1000	<1000
Benz(a)anthracene	<1000	<1000	<1000	<1000	<1000
Benzo(b)fluoranthene	<1000	<1000	<1000	<1000	<1000
Benzo(k)fluoranthene	<1000	<1000	<1000	<1000	<1000
Benzo(a)pyrene	<1000	<1000	<1000	<1000	<1000
Chrysene	<1000	<1000	<1000	<1000	<1000
para-Cresol	<1000	<1000	<1000	<1000	<1000
Fluoranthene	<1000	<1000	<1000	<1000	<1000
Fluorene	<1000	<1000	<1000	<1000	<1000
Indeno(1,2,3-cd)pyrene	<1000	<1000	<1000	<1000	<1000
Naphthalene	<1000	<1000	<1000	<1000	<1000
Phenanthrene	<1000	<1000	<1000	<1000	<1000
Phenol	<1000	<1000	<1000	<1000	<1000
Pyrene	<1000	<1000	<1000	<1000	<1000
BDAT Metals (mg/kg)					
Antimony	<3.2	<2.0	<2.0	<2.0	<3.2
Arsenic	9.9	11	6.7	12	5.3
Barium	317	56	53	41	63
Beryllium	0.60	<0.5	<0.5	<0.5	0.36
Cadmium	<0.40	<1.0	<1.0	<1.0	<0.40
Chromium	34	5.2	2.2	2.1	7.6
Copper	746	44	43	50	94
Lead	44	8.2	8.3	5.9	7.2
Mercury	<0.10	2.8	2.9	3.3	<0.1
Nickel	10	<4.0	<4.0	<4.0	4.5
Selenium	1.4	1.6	<0.50	5.9	<0.5
Silver	<0.60	<5.0	<5.0	<5.0	<6.0
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium	17	9.7	6.6	8.1	10
Zinc	50	13	13	12	21

Table 4-3 (Continued)

ANALYTICAL RESULTS FOR KILN ASH GENERATED BY ROTARY KILN INCINERATION OF K087

Constituent/parameter (units)	Concentration				
	Sample Set #				
	1	2	3	4	5
BDAT TCLP: Metals (µg/l)					
Antimony	425	<20	<20	<20	<32
Arsenic	96	33	25	19	43
Barium	609	344	547	641	546
Beryllium	3.3	<5.0	<5.0	<5.0	2.5
Cadmium	<4.0	<10	<10	<10	<4.0
Chromium	62	<20	<20	<20	8.7
Copper	<6.0	52	1110	346	497
Lead	29	40	53	20	106
Mercury	<0.2	<0.30	<0.30	<0.30	<0.2
Nickel	93	<40	<40	<40	16
Selenium	<50	7.3	<5.0	<5.0	<5.0
Silver	<6.0	<50	<50	<50	<6.0
Thallium	<10	<10	<10	<10	<500
Vanadium	<30	<50	<50	<50	8.3
Zinc	169	202	218	288	256
BDAT Inorganics Other Than Metals (mg/kg)					
Cyanide	0.74	<0.50	<0.50	<0.50	<0.50
Fluoride	<1.0	-	-	-	<0.25
Sulfide	35.5	36.3	144	116	11.0
Non-BDAT Volatile Organics (µg/kg)					
Styrene	<25	<25	<25	<25	<25
Non-BDAT Semivolatile Organics (µg/kg)					
Dibenzofuran	<1000	<1000	<1000	<1000	<1000
2-Methylnaphthalene	<1000	<1000	<1000	<1000	<1000
Other Parameters (mg/kg)					
Total organic carbon	350000	553000	402000	316000	244000
Total chlorides	9.7	6.8	14.1	14.6	16.0
Total organic halides	375	18.3	32.1	19.8	133

- = Not analyzed.

Note: This table shows the concentrations or maximum potential concentrations in the kiln ash for all constituents that were detected in the nonwastewater residuals generated from treatment of the waste.

Source: BDAT Background Document for K087 (Reference 7).

Table 4-4

ANALYTICAL RESULTS FOR SCRUBBER WATER GENERATED BY ROTARY KILN INCINERATION OF K087

Constituent/parameter (units)	Concentration					
	Sample[a]					
	1	2	3	4	5	6
BDAT Volatile Organics (µg/l)						
Benzene	<5	<5	<5	<5	<5	<5
Methyl ethyl ketone	14	<10	<10	<10	<10	<10
Toluene	<5	8	<5	<5	<5	<5
Xylenes	<5	<5	<5	<5	<5	<5
BDAT Semivolatile Organics (µg/l)						
Acenaphthalene	<10	<10	<10	<10	<10	<10
Anthracene	<10	<10	<10	<10	<10	<10
Benz(a)anthracene	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10
Chrysene	<10	<10	<10	<10	<10	<10
para-Cresol	<10	<10	<10	<10	<10	<10
Fluoranthene	<10	<10	<10	<10	<10	<10
Fluorene	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene	<10	<10	<10	<10	<10	<10
Naphthalene	<10	<10	<10	<10	<10	<10
Phenanthrene	<10	<10	<10	<10	<10	<10
Phenol	<10	<10	<10	<10	<10	<10
Pyrene	<10	<10	<10	<10	<10	<10
BDAT Metals (µg/l)						
Antimony	<32	<33	<20	39	<20	<32
Arsenic	211	191	148	257	300	342
Barium	65	350	302	340	290	102
Beryllium	<1.0	1.3	<5.0	<5.0	<5.0	<1.0
Cadmium	26	15	21	41	42	51
Chromium	306	304	155	236	255	259
Copper	1050	1100	948	1240	1160	1240
Lead	5610	7000	3240	4780	5610	4840
Mercury	0.23	<0.20	0.48	0.33	0.30	0.40
Nickel	<11	<11	<40	<40	<40	<11
Selenium	81	61	5.7	83	87	87
Silver	<6.0	<7.0	<50	<50	<50	<6.0
Thallium	126	109	77	108	96	136
Vanadium	15	12	<50	<50	<50	18
Zinc	2250	2040	1740	2910	2670	2960

Table 4-4 (Continued)

ANALYTICAL RESULTS FOR SCRUBBER WATER GENERATED BY ROTARY KILN INCINERATION OF K087

Constituent/parameter (units)	Concentration					
	Sample[a]					
	1	2	3	4	5	6
BDAT Inorganics Other Than Metals (mg/l)						
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	3.38	2.99	2.38	-	-	3.54
Sulfide	<1.0	<1.0	11.9	<1.0	<1.0	<1.0
Non-BDAT Volatile Organics (µg/l)						
Styrene	<5	<5	<5	<5	<5	<5
Non-BDAT Semivolatile Organics (µg/l)						
Dibenzofuran	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	<10	<10	<10	<10	<10	<10
Other Parameters						
Total organic carbon (mg/l)	37.9	26.1	88.9	148	111	94.1
Total solids (mg/l)	2240	2080	1910	2350	2480	2720
Total chlorides (mg/l)	51.3	57.9	48.5	51.0	58.3	56.0
Total organic halides (µg/l)	33.7	33.2	48.7	23.3	27.6	27.4

- = Not analyzed.

Note: This table shows concentrations or maximum potential concentrations in the scrubber water for all constituents detected in the wastewater residuals generated from treatment of the waste.

[a] Scrubber water samples are not assigned a sample set number. See the K087 OER for specific collection times.

Source: BDAT Background Document for K087 (Reference 7).

Table 4-5

OPERATING DATA FOR THE K087 INCINERATION TEST

Sample Set/ Date	Time	Kiln rotational speed (rpm)	Temperature (°F)[a]			Feed rate[c] (lb/hr)	Emissions[b]				Pressure drop venturi (in H_2O)	Scrubber effluent water pH	Scrubber effluent water flow rate (gpm)
			Kiln	Afterburner	Scrubber effluent water		O_2 (% vol)	CO_2 (% vol)	CO[d] (ppm)	THC (ppm)			
Target values:[e]		0.2	1800	2150	<180	105	6-8	-	<1000	0	20	7.0-8.0	1.5
Sample Set #1 8/25/87	8:40-15:10	0.2	1400-2000	1950-2150	165-170	77	0-19	7.0->10	0->100	-[f]	9-17[g]	6.9-7.8	1.5
Sample Set #2 8/25/87 (scrubber effluent water data)	14:10-18:25	0.2	1600-2000	1850-2150	143-170	80	0-18	6.4->10	0->100	-[f]	7-14[g]	7.0-7.5	1.5
Sample Set #2 8/26/87 (kiln ash data)	10:20-13:00	0.2	1350-1875	1925-2150	165-170	97	0-13	3.8->10	0->100	0->10[h]	7-22[g]	7.0-7.6	1.5
Sample Set #3 8/28/87	9:50-14:15	0.2	1675-2000	1900-2150	165-170	89	0-14	5.4->10	0-1500	0->10[h]	20	7.2	1.5
Sample Set #4 8/28/87	13:15-16:50	0.2	1625-2000	2050-2150	165-170	87	2-12	6.8->10	0-800	0	20	7.2	1.5
Sample Set #5 8/28/87	15:50-18:25	0.2	1725-2050	2125-2175	165-170	90	4-12	6.4->10	0-360	0	20	7.2	1.5

Table 4-5 (Continued)

OPERATING DATA FOR THE K087 INCINERATION TEST

[a]Kiln and afterburner temperatures presented on this table are minimum and maximum values according to the data logger strip charts, which are presented in Figures C-1 through C-5 in Appendix C of the BDAT Background Document for K087 (Reference 7). Note that the thermocouples connected to the American Combustion printer are used by the controller for adjusting operating conditions.

[b]The minimum O_2 and maximum CO values typically correspond to periods of flameout in the kiln and/or afterburner. See Figures B, C, and D (in Appendix C of the BDAT Background Document for K087 (Reference 7)) for strip charts showing continuous emissions monitoring (CEM) of O_2, CO_2, and CO, respectively.

[c]Includes weight of fiber drum packaging (1.1 pounds per drum) and weight of waste (approximately 3.5 pounds per drum). Waste feed rate alone was targeted at 80 lbs/hr.

[d]Upper end of detection limit for CO was raised from 100 ppm on August 25 and 26 to 2000 ppm on August 28 by switching to another strip chart recorder.

[e]The targeted values represent the optimum operating conditions to provide the most effective treatment for hazardous organic constituents. EPA recognizes that during normal operation, these optimum conditions cannot be sustained at all times. EPA will determine whether the treatment system has been adequately operated based on the magnitude and duration of the fluctuations from the targeted values.

[f]THC analyzer was down for repairs.

[g]Needle readout failed during the test burn; operator speculated that pressure drop was in reality 20 in H_2O on 8/25 and 8/26. Operator recorded values from a second readout located in the bay area on 8/28.

[h]The analyzer registered four sharp peaks on 8/26 at approximately 10:25, 10:28, 11:00, and 11:40 and one sharp peak on 8/28 at approximately 09:59.

Source: BDAT Background Document for K087 (Reference 7).

5.0 IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section discusses technologies that are available for treatment of K035 nonwastewaters and wastewaters and identifies proposed BDAT for K035 nonwastewaters and wastewaters.

For a treatment technology to be identified as BDAT, the treatment performance data are first screened to determine whether they represent a well-designed and well-operated treatment system, whether sufficient analytical quality assurance/quality control measures were employed to ensure the accuracy of the data, and whether the appropriate measures of performance were used to assess the performance of the particular treatment technology.

The treatment performance data and the design and operating data collected during the test of rotary kiln incineration of K087 (Reference 6) were reviewed for the points described above. The appropriate measure of performance (total constituent concentration) was used to assess the treatment system. Additionally, the Agency had no reason to believe that this treatment system was not well-designed and well-operated, or that insufficient analytical quality assurance/quality control measures were employed in generating treatment performance data.

An available treatment technology is one that (1) is not a proprietary or patented process that cannot be purchased or licensed from the proprietor (i.e., it must be commercially available), and (2) substantially

diminishes the toxicity of the waste or substantially reduces the likelihood of migration of hazardous constituents from the waste. The technology that is demonstrated for treatment of K035, incineration, is considered to be commercially available and to provide substantial treatment of the waste. Therefore, incineration is an "available" technology for treatment of K035.

In summary, incineration has been determined to be demonstrated and available for treatment of nonwastewater and wastewater forms of K035. However, because the Agency does not have treatment performance data for any other technologies treating K035 or similar wastes, this treatment technology is considered to be the best. Therefore, the best demonstrated available technology (BDAT) for K035 has been determined to be incineration.

6.0 SELECTION OF CONSTITUENTS PROPOSED FOR REGULATION

The Agency has developed a list of hazardous constituents (the BDAT Constituent List, presented in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1)) from which constituents to be regulated are selected for regulation. EPA may revise this list as additional data and information become available. The list is divided into the following categories: volatile organics, semivolatile organics, metals, inorganics other than metals, organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorus insecticides, PCBs, and dioxins and furans. This section presents the rationale for the selection of constituents being proposed for regulation in wastewater and nonwastewater forms of K035.

Generally, constituents selected for proposed regulation must satisfy the following criteria:

(1) The constituent must be on the BDAT List of regulated constituents. Presence on the BDAT List means that approved methods to analyze for the constituent in treated waste matrices exist.

(2) The constituent must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

From a group of constituents that are eligible for regulation, because they meet the above criteria, EPA may select a subset of constituents that represent the broader group. For example, from a group of constituents that react similarly to treatment, the Agency may select for regulation only

those constituents that (1) are the most difficult to treat, based on waste characteristics affecting performance of treatment; (2) are representative of other constituents in the waste, based on structural similarities; or (3) are present in the untreated waste in the highest concentrations. Selecting a subset of constituents for regulation is done to facilitate implementation of the compliance and enforcement program.

The Agency initially considered all constituents on the BDAT List for regulation. Available K035 characterization data for all BDAT List constituents are summarized in Table 6-1. (All tables are presented at the end of Section 6.0.) When data are available for more than one sample set, a range of detected concentrations is shown in the table for all constituents quantified in the untreated K035. Constituents for which analytical results were not quantified at or above the detection limit are identified by the notation "ND" (not detected). Constituents for which no analysis was performed are identified by "NA" (not analyzed).

6.1 BDAT List Constituents Not Selected for Proposed Regulation

The Agency is not regulating all of the BDAT List constituents initially considered for regulation. As discussed further below, a BDAT List constituent was deleted from further consideration for regulation if (1) the constituent was not detected in the untreated and/or treated wastes, (2) the constituent was not analyzed for in the untreated waste, or (3) other reasons, as discussed below. BDAT List constituents that remained following the

deletions described in this subsection were further considered for regulation. These constituents were further considered for regulation and are listed in Table 6-2 at the end of this section.

BDAT List Constituents That Were Not Detected in the Untreated Waste. BDAT List constituents that were not detected in the untreated waste (labelled "ND" in Table 6-1) were deleted from consideration for proposed regulation.

BDAT List Constituents That Were Not Analyzed for in the Untreated Waste. Some BDAT List constituents were deleted from consideration for proposed regulation because they were not analyzed for in the untreated waste (labelled "NA" in Table 6-1). These constituents were not analyzed for in the untreated waste because it was extremely unlikely that these constituents would be present in the waste, based on knowledge of the process generating the waste.

BDAT List Constituents That Were Deleted From Consideration for Proposed Regulation for Other Reasons. Copper, vanadium, and zinc were considered for proposed regulation in K035 nonwastewaters and wastewaters but were not selected as constituents to be proposed for regulation. Although copper cyanide, vanadium pentoxide, and zinc cyanide are listed in Appendix VIII of 40 CFR Part 261, the metals are not listed individually. The Agency is only proposing to regulate copper, vanadium, and/or zinc when they are indicators of performance of treatment for other Appendix VIII constituents.

For K035 nonwastewaters and wastewaters, copper, vanadium, and zinc have not been identified as indicators of treatment performance for other Appendix VIII constituents and therefore, are not being proposed for regulation.

Fluoride and sulfide were deleted from consideration for proposed regulation in K035 because the technology determined to be BDAT for K035 (incineration) does not provide effective treatment for these BDAT List constituents. Moreover, the Agency is unaware of any demonstrated technology for treatment of fluoride and sulfide in K035 or similar wastes.

The remaining BDAT List metal constituents that were detected in the untreated waste -- arsenic, barium, beryllium, cadmium, chromium (total), hexavalent chromium, lead, mercury, nickel, selenium, and thallium -- were not present at treatable concentrations. Therefore, it would not be possible to show treatment for these constituents. Accordingly, these 11 BDAT List constituents were deleted from consideration for proposed regulation.

6.2 Selection of BDAT List Constituents for Proposed Regulation

This subsection presents the BDAT List constituents that were selected for proposed regulation in nonwastewater and wastewater forms of K035.

Nonwastewaters

Constituents considered further for proposed regulation in nonwastewater forms of K035 were selected from the BDAT List constituents that were detected in the untreated waste, unless they were deleted from consideration as discussed in Section 6.1. The constituents that remained following the deletions discussed in Section 6.1 are listed in Table 6-2 of this document.

Table 6-3 presents each constituent selected for proposed regulation in K035 nonwastewaters after consideration of (1) the constituent concentration in the untreated waste, (2) whether the constituent is adequately controlled by regulation of another constituent, and (3) the relative difficulty in achieving effective treatment of the constituent by the technology identified as BDAT for K035 nonwastewaters (incineration).

The Agency's determination of adequate control for organic constituents was based on (1) an evaluation of the characteristics of the constituents that would affect the performance of incineration relative to the ash residual, specifically, their estimated boiling points, and (2) the structural similarities among the constituents.

Thirty-three BDAT List organic constituents (shown in Table 6-2) were further considered for proposed regulation in nonwastewater forms of K035 due to their presence in the untreated waste. The boiling points of these thirty-three constituents, and their concentrations in the untreated waste,

were compared to determine which constituents had higher boiling points and higher concentrations in the untreated waste. Twenty-one constituents were then deleted from consideration for proposed regulation because (1) they are believed to be adequately controlled by incineration of the 12 remaining organic constituents in K035 nonwastewaters and/or (2) they are believed to be treated to similar concentrations as the 12 remaining constituents based on structural similarities.

Based on the above discussion, the 12 BDAT List organic constituents selected for proposed regulation in K035 nonwastewaters (shown in Table 6-3) are acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

Wastewaters

Constituents considered further for proposed regulation in wastewater forms of K035 were selected from the BDAT List constituents that were detected in the untreated waste, unless they were deleted from consideration as discussed in Section 6.1. The constituents that remained following the deletions discussed in Section 6.1 are listed in Table 6-2 of this document.

Table 6-4 presents each constituent selected for proposed regulation in K035 wastewaters after consideration of (1) the constituent concentration in the untreated waste, (2) whether the constituent is adequately controlled

by regulation of another constituent, and (3) the relative difficulty in achieving effective treatment of the constituent by the technology identified as BDAT for K035 wastewaters (incineration).

The Agency's determination of adequate control for organic constituents was based on (1) an evaluation of the characteristics of the constituents that would affect the performance of incineration relative to the scrubber water residual, specifically, their estimated bond dissociation energies, and (2) the structural similarities among the constituents.

Thirty-three BDAT List organic constituents (shown in Table 6-2) were further considered for proposed regulation in wastewater forms of K035 due to their presence in the untreated waste. The bond dissociation energies of these 33 constituents, and their concentrations in the untreated waste were compared to determine which constituents had higher bond dissociation energies and higher concentrations in the untreated waste. Twenty-four constituents were deleted from consideration for proposed regulation because (1) they are believed to be adequately controlled by incineration of the organic constituents selected for proposed regulation in K035 wastewaters and/or (2) they are believed to be treated to similar concentrations as those constituents selected for proposed regulation based on structural similarities.

Based on the above discussion, the nine BDAT List organic constituents selected for proposed regulation in K035 wastewaters (shown in Table 6-4)

are benz(a)anthracene, chrysene, o-cresol, p-cresol, fluoranthene, naphthalene, phenanthrene, phenol, and pyrene.

Table 6-1

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Volatiles	
222.	Acetone	ND
1.	Acetonitrile	ND
2.	Acrolein	ND
3.	Acrylonitrile	ND
4.	Benzene	4.5-3,700
5.	Bromodichloromethane	ND
6.	Bromomethane	ND
223.	n-Butyl alcohol	ND
7.	Carbon tetrachloride	ND
8.	Carbon disulfide	0.053
9.	Chlorobenzene	ND
10.	2-Chlorol,3-butadiene	ND
11.	Chlorodibromomethane	ND
12.	Chloroethane	ND
13	2-Chloroethyl vinyl ether	ND
14.	Chloroform	ND
15.	Chloromethane	ND
16.	3-Chloropropene	ND
17.	1,2-Dibromo3-chloropropane	ND
18.	1,2-Dibromoethane	ND
19.	Dibromomethane	ND
20.	transl,4-Dichloro2-butene	ND
21.	Dichlorodifluoromethane	ND
22.	1,1-Dichloroethane	ND
23.	1,2-Dichloroethane	ND
24.	1,1-Dichloroethylene	ND
25.	trans-1,2-Dichloroethene	ND
26.	1,2-Dichloropropane	ND
27.	trans-1,3-Dichloropropene	ND
28.	cisl,3-Dichloropropene	ND
29.	1,4-Dioxane	ND
225.	Ethyl acetate	ND
226.	Ethyl benzene	0.027-1,100
30.	Ethyl cyanide	ND
227.	Ethyl ether	ND
31.	Ethyl methacrylate	ND
214.	Ethylene oxide	ND
32.	Iodomethane	ND

ND - Not detected.

Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Volatiles (Continued)	
33.	Isobutyl alcohol	ND
228.	Methanol	9.7
34.	Methyl ethyl ketone	ND
229.	Methyl isobutyl ketone	ND
35.	Methyl methacrylate	ND
37.	Methacrylonitrile	ND
38.	Methylene chloride	0.026
39.	Pyridine	610
40.	1,1,1,2-Tetrachloroethane	ND
41.	1,1,2,2-Tetrachloroethane	ND
42.	Tetrachloroethene	ND
43.	Toluene	0.35-8,700
44.	Tribromomethane	ND
45.	1,1,1-Trichloroethane	ND
46.	1,1,2-Trichloroethane	ND
47.	Trichloroethene	ND
48.	Trichloromonofluoromethane	ND
49.	1,2,3-Trichloropropane	ND
231.	1,1,2-Trichlorol,2,2-trifluoroethane	ND
50.	Vinyl chloride	ND
215.-217.	Xylenes (total)	0.018-2,000
	Semivolatiles	
51.	Acenaphthalene	9-7,600
52.	Acenaphthene	32-18,000
53.	Acetophenone	ND
54.	2-Acetylaminofluorene	ND
233.	Acrylamide	ND
55.	4-Aminobiphenyl	ND
56.	Aniline	ND
57.	Anthracene	38-10,000
58.	Aramite	ND
59.	Benz(a)anthracene	19-5,400
218.	Benzal chloride	ND
60.	Benzenethiol	19
62.	Benzo(a)pyrene	6-2,400

ND - Not detected.
Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Semivolatiles (Continued)	
63.	Benzo(b)fluoranthene	7-2,300
64.	Benzo(ghi)perylene	3.6-1,100
65.	Benzo(k)fluoranthene	4.5-1,700
66.	p-Benzoquinone	NA
67.	Bis(2-chloroethoxy)methane	ND
68.	Bis(2-chloroethyl)ether	ND
69.	Bis(2-chloroisopropyl)ether	ND
70.	Bis(2-ethylhexyl)phthalate	ND
71.	4-Bromophenyl phenyl ether	ND
72.	Butyl benzyl phthalate	ND
73.	2-sec-Butyl4,6-dinitrophenol	ND
74.	p-Chloroaniline	ND
75.	Chlorobenzilate	ND
76.	p-Chloro-m-cresol	ND
77.	2-Chloronaphthalene	ND
78.	2-Chlorophenol	ND
80.	Chrysene	22-5,800
81.	ortho-Cresol	31-3,300
82.	para-Cresol	19-4,100
232.	Cyclohexanone	ND
83.	Dibenz(a,h)anthracene	2,600
84.	Dibenzo(a,e)pyrene	ND
86.	m-Dichlorobenzene	ND
87.	o-Dichlorobenzene	ND
88.	p-Dichlorobenzene	ND
89.	3,3'-Dichlorobenzidine	ND
234.	cis-1,4-Dichloro-2-butene	ND
90.	2,4-Dichlorophenol	ND
91.	2,6-Dichlorophenol	ND
92.	Diethyl phthalate	ND
93.	3,3'-Dimethoxybenzidine	ND
94.	p-Dimethylaminoazobenzene	ND
95.	3,3'-Dimethylbenzidine	ND
96.	2,4-Dimethylphenol	7-2,600
97.	Dimethyl phthalate	ND
98.	Di-n-butyl phthalate	ND
99.	1,4-Dinitrobenzene	ND
100.	4,6-Dinitro-o-cresol	ND
101.	2,4-Dinitrophenol	ND

ND - Not detected.
NA - Not analyzed.
Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Semivolatiles (Continued)	
102.	2,4-Dinitrotoluene	ND
103.	2,6-Dinitrotoluene	ND
104.	Di-n-octyl phthalate	ND
105.	Di-n-propylnitrosamine	ND
106.	Diphenylamine	ND
219.	Diphenylnitrosamine	ND
107.	1,2-Diphenylhydrazine	ND
108.	Fluoranthene	76-21,000
109.	Fluorene	43-17,000
110.	Hexachlorobenzene	ND
111.	Hexachlorobutadiene	ND
112.	Hexachlorocyclopentadiene	ND
113.	Hexachloroethane	ND
114.	Hexachlorophene	NA
115.	Hexachloropropene	ND
116.	Indeno(1,2,3-cd)pyrene	4.6-1,100
117.	Isosafrole	ND
118.	Methapyrilene	ND
119.	3-Methylcholanthrene	ND
120.	4,4'-Methylenebis(2-chloroaniline)	ND
36.	Methyl methanesulfonate	ND
121.	Naphthalene	370-220,000
122.	1,4-Naphthoquinone	ND
123.	1-Naphthylamine	ND
124.	2-Naphthylamine	ND
125.	p-Nitroaniline	ND
126.	Nitrobenzene	ND
127.	4-Nitrophenol	ND
128.	n-Nitrosodi-n-butylamine	ND
129.	n-Nitrosodiethylamine	ND
130.	n-Nitrosodimethylamine	ND
131.	n-Nitrosomethylethylamine	ND
132.	n-Nitrosomorpholine	ND
133.	n-Nitrosopiperidine	ND
134.	n-Nitrosopyrrolidine	ND
135.	5-Nitro-o-toluidine	ND

ND - Not detected.
NA - Not analyzed.
Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Semivolatiles (Continued)	
136.	Pentachlorobenzene	ND
137.	Pentachloroethane	ND
138.	Pentachloronitrobenzene	ND
139.	Pentachlorophenol	ND
140.	Phenacetin	ND
141.	Phenanthrene	ND
142.	Phenol	150-50,000
220.	Phthalic anhydride	510-4,000
144.	Pronamide	ND
145.	Pyrene	ND
146.	Resorcinol	64-19,000
147.	Safrole	21
148.	1,2,4,5-Tetrachlorobenzene	ND
149.	2,3,4,6-Tetrachlorophenol	ND
150.	1,2,4-Trichlorobenzene	ND
151.	2,4,5-Trichlorophenol	ND
152.	2,4,6-Trichlorophenol	ND
153.	Tris(2,3-dibromopropyl)phosphate	NA
	Metals	
154.	Antimony	ND
155.	Arsenic	0.44-1.61
156.	Barium	0.2-108
157.	Beryllium	0.2
158.	Cadmium	1.22-3.77
159.	Chromium (total)	2.11-20.8
221.	Chromium (hexavalent)	0.28-0.6
160.	Copper	1.98-315
161.	Lead	0.49-47
162.	Mercury	2.87-134
163.	Nickel	516
164.	Selenium	0.61-1.74
165.	Silver	ND
166.	Thallium	0.13-0.55
167.	Vanadium	1.55-9.92
168.	Zinc	3.22-61.6

ND - Not detected.
NA - Not analyzed.
Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K035 (ppm)
	Inorganics	
169.	Cyanide	23.7-1,080
170.	Fluoride	2.42-80.1
171.	Sulfide	43-291
	Organochlorine pesticides	
172.	Aldrin	ND
173.	alpha-BHC	ND
174.	beta-BHC	ND
175	delta-BHC	ND
176.	gamma-BHC	ND
177.	Chlordane	ND
178.	DDD	ND
235.	o,p'-DDD	ND
179.	DDE	ND
236.	o,p'-DDE	ND
180.	DDT	ND
237.	o,p'-DDT	ND
181.	Dieldrin	ND
182.	Endosulfan I	ND
183.	Endosulfan II	ND
238.	Endosulfan sulfate	ND
184.	Endrin	ND
185.	Endrin aldehyde	ND
186.	Heptachlor	ND
187.	Heptachlor epoxide	ND
188.	Isodrin	ND
189.	Kepone	ND
190.	Methoxychlor	ND
191.	Toxaphene	ND
	Phenoxyacetic acid herbicides	
192.	2,4-Dichlorophenoxyacetic acid	ND
193.	Silvex	ND
194.	2,4,5-T	ND

ND - Not detected.

Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K035

BDAT Reference No.	Parameter	Concentration in Untreated K025 (ppm)
	Organophosphorous insecticides	
195.	Disulfoton	ND
196.	Famphur	ND
197.	Methyl parathion	ND
198.	Parathion	ND
199.	Phorate	ND
	PCBs	
200.	Aroclor 1016	ND
201.	Aroclor 1221	ND
202.	Aroclor 1232	ND
203.	Aroclor 1242	ND
204.	Aroclor 1248	ND
205.	Aroclor 1254	ND
206.	Aroclor 1260	ND
	Dioxins and furans	
207.	Hexachlorodibenzo-p-dioxins	ND
208.	Hexachlorodibenzofurans	ND
209.	Pentachlorodibenzo-p-dioxins	ND
210.	Pentachlorodibenzofurans	ND
211.	Tetrachlorodibenzo-p-dioxins	ND
212.	Tetrachlorodibenzofurans	ND
213.	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND

ND - Not detected.

Source: K035 Characterization Report for Reilly Industries Inc., Provo, Utah, and Granite City, Illinois (Reference 4).

Table 6-2

BDAT LIST CONSTITUENTS FURTHER CONSIDERED FOR PROPOSED REGULATION[a] IN K035 NONWASTEWATER AND WASTEWATER AFTER INITIAL SCREENING

4.	Benzene
8.	Carbon disulfide
226.	Ethyl benzene
228.	Methanol
38.	Methylene chloride
39.	Pyridine
43.	Toluene
215-217.	Xylenes (total)
51.	Acenaphthalene
52.	Acenaphthene
57.	Anthracene
59.	Benz(a)anthracene
60.	Benzenethiol
62.	Benzo(a)pyrene
63.	Benzo(b)fluoranthene
64.	Benzo(ghi)perylene
65.	Benzo(k)fluoranthene
80.	Chrysene
81.	o-Cresol
82.	p-Cresol
83.	Dibenz(a,h)anthracene
96.	2,4-Dimethylphenol
108.	Fluoranthene
109.	Fluorene
116.	Indeno(1,2,3-cd)pyrene
121.	Naphthalene
141.	Phenanthrene
142.	Phenol
145.	Pyrene
146.	Resorcinol
169.	Cyanide

[a]All constituents on this list were detected in untreated K035 and were either selected for proposed regulation (as shown in Tables 6-3 and 6-4) or are believed to be controlled by regulation of another constituent.

Table 6-3

BDAT LIST CONSTITUENTS SELECTED FOR PROPOSED REGULATION
IN K035

NONWASTEWATERS

52.	Acenaphthene
57.	Anthracene
59.	Benz(a)anthracene
62.	Benzo(a)pyrene
80.	Chrysene
83.	Dibenz(a,h)anthracene
108.	Fluoranthene
109.	Fluorene
116.	Indeno(1,2,3-cd)pyrene
121.	Naphthalene
141.	Phenanthrene
145.	Pyrene

Table 6-4

BDAT LIST CONSTITUENTS SELECTED FOR PROPOSED REGULATION
IN K035

WASTEWATERS

59.	Benz(a)anthracene
80.	Chrysene
81.	o-Cresol
82.	p-Cresol
108.	Fluoranthene
121.	Naphthalene
141.	Phenanthrene
142.	Phenol
145.	Pyrene

7.0 CALCULATION OF PROPOSED BDAT TREATMENT STANDARDS

The Agency bases numerical treatment standards for constituents proposed for regulation on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available treatment performance data, and the data must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures. The purpose of this section is to calculate proposed treatment standards for K035 nonwastewaters and wastewaters for the constituents selected for proposed regulation using the available treatment performance data from the treatment technology identified as BDAT.

Proposed BDAT treatment standards for K035 nonwastewaters and wastewaters are based on the demonstrated technology of incineration.

Before treatment standards are calculated, the treatment performance data are corrected to account for analytical interferences associated with the chemical matrices of the samples. A complete discussion of the accuracy correction of treatment data is provided in Appendix A. Appendix A also contains the matrix spike recoveries and accuracy correction factors used to correct the treatment performance data, as well as the corrected treatment performance data.

After treatment performance data are corrected for accuracy, the arithmetic average of the corrected data is calculated for each regulated

constituent. In cases where the constituent is not detected in the treatment residual at or above its detection limit, the detection limit is used to calculate the average constituent concentration in the treated waste. Tables 7-1 and 7-2 at the end of this section present the averages of the corrected treatment performance data for each constituent proposed for regulation in K035 nonwastewaters and wastewaters, respectively.

The next step in calculating treatment standards is to determine the variability factor (VF) for each regulated constituent. The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and treatment sample analysis. (For more information on calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).) Variability factors for the constituents proposed for regulation in K035 are shown in Tables 7-1 and 7-2.

Finally, the treatment standard is calculated for each constituent proposed for regulation by multiplying the average of the correct treatment performance values by the variability factor for the constituent. Proposed treatment standards for nonwastewater and wastewater forms of K035 are presented in Tables 7-1 and 7-2 and are discussed in greater detail in the following sections.

7.1 Calculation of Proposed Treatment Standards for K035 Nonwastewaters

Treatment performance data for the ash from rotary kiln incineration of K035 are not available. Therefore, the Agency is transferring performance data from treatment of organic constituents in K087 to develop treatment standards for organic constituents in nonwastewater forms of K035. The rationale for this transfer is presented in Section 4.0 of this document.

Incineration generally results in the generation of ash (a nonwastewater) and combustion gas scrubber water (a wastewater). The best measure of performance for a destruction technology, such as incineration, is the total amount of each constituent of concern remaining after treatment. Therefore, BDAT treatment standards for organic constituents proposed for regulation in K035 nonwastewaters were calculated based on total constituent concentration data transferred from K087 incinerator ash (Reference 6).

Proposed treatment standards for organic constituents in K035 nonwastewaters were calculated using five sample sets of data for rotary kiln incineration of K087 (Reference 6). Tables 4-2 and 4-3 of this document present the total concentrations of each organic constituent detected in untreated K087 and the treated nonwastewater residual (ash). Treatment performance data for each constituent being proposed for regulation in K035 nonwastewaters were transferred from data for the same constituent in K087 if that constituent was detected in the untreated K087. For a constituent that was not detected in the untreated K087, a treatment standard was developed based on treatment performance data from another constituent that was detected in the untreated K087 that was tested.

The particular constituent from which data are transferred is determined based on the characteristics of the waste that affect treatment performance by incineration with respect to the nonwastewater residual (i.e., incinerator ash) and the structural similarities between the constituents from and to which data are transferred. In the rotary kiln, energy in the form of heat is transferred to the waste to volatilize the organic waste constituents. To determine whether one constituent is volatilized similarly to another constituent, the Agency examines the boiling points and the structural similarities of the constituents.

In general, the Agency believes that a constituent with a higher boiling point (bp) is more difficult to treat than a constituent with a lower boiling point. Whenever possible, treatment performance data were transferred to K035 nonwastewaters from constituents detected in untreated K087 that had equal or higher boiling points. Specific cases where data were transferred from another constituent are noted in Table 7-1 at the end of this section.

The calculation of the proposed treatment standards for each BDAT List organic constituent proposed for regulation in K035 nonwastewaters is shown in Table 7-1.

7.2 Calculation of Proposed Treatment Standards for K035 Wastewaters

Treatment performance data for the scrubber water from rotary kiln incineration of K035 are not available. Therefore, the Agency is transferring

performance data from treatment of organic constituents in K087 to develop treatment standards for organic constituents in wastewater forms of K035. The rationale for this transfer is presented in Section 4.0 of this document.

Incineration generally results in the generation of ash (a nonwastewater) and combustion gas scrubber water (a wastewater). The best measure of performance for a destruction technology, such as incineration, is the total amount of each constituent of concern remaining after treatment. Therefore, BDAT treatment standards for organic constituents proposed for regulation in K035 wastewaters were calculated based on total constituent concentration data transferred from the scrubber water residual from incineration of K087 (Reference 6).

Proposed treatment standards for organic constituents in K035 were calculated using six sample sets of data from rotary kiln incineration of K087. Tables 4-2 and 4-4 of this document present the total concentrations of each organic constituent detected in the untreated K087 and the treated wastewater residual (scrubber water). Treatment performance data for each constituent being proposed for regulation in K035 wastewaters were transferred from data for the same constituent in K087 if that constituent was detected in the untreated K087. For a constituent that was not detected in the untreated K087, a treatment standard was developed based on treatment performance data from another constituent that was detected in the untreated K087 that was tested.

The particular constituent from which data are transferred is determined based on the characteristics of the waste that affect treatment performance of incineration with respect to the wastewater residual (i.e., scrubber water) and the structural similarities between the constituents from and to which data are transferred. In the secondary chamber (or afterburner), energy in the form of heat is added to destabilize chemical bonds to initiate the combustion reactions. To determine whether one constituent is destabilized similarly to another constituent, the Agency examines the bond dissociation energies and the structural similarities of the constituents.

In general, the Agency believes that a constituent with a higher bond dissociation energy (BDE) is more difficult to treat than a constituent with a lower BDE. Whenever possible, treatment performance data were transferred to K035 wastewaters from constituents detected in untreated K087 that had an equal or higher BDE. Specific cases where data were transferred from another constituent are noted on Table 7-2 at the end of this section.

The calculation of the treatment standards for each BDAT List organic constituent proposed for regulation in K035 wastewaters is shown in Table 7-2.

Table 7-1

CALCULATION OF TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K035

NONWASTEWATERS

BDAT List Constituent Proposed for Regulation	Constituent from Which Treatment Performance Data in K087 Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
52. Acenaphthene	Fluorene	1.220	2.8	3.4
57. Anthracene	Anthracene	1.217	2.8	3.4
59. Benz(a)anthracene	Benz(a)anthracene	1.217	2.8	3.4
62. Benzo(a)pyrene	Benzo(a)pyrene	1.217	2.8	3.4
80. Chrysene	Chrysene	1.217	2.8	3.4
83. Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	1.217	2.8	3.4
108. Fluoranthene	Fluoranthene	1.217	2.8	3.4
109. Fluorene	Fluorene	1.217	2.8	3.4
116. Indeno(1,2,3-cd)pyrene	Indeno-1,2,3-cd)pyrene	1.217	2.8	3.4
121. Naphthalene	Naphthalene	1.217	2.8	3.4
141. Phenanthrene	Phenanthrene	1.217	2.8	3.4
145. Pyrene	Pyrene	2.941	2.8	8.2

Table 7-2

CALCULATION OF TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K035

WASTEWATERS

BDAT List Constituent Proposed for Regulation	Constituent from Which Treatment Performance Data in K087 Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
59. Benz(a)anthracene	Benz(a)anthracene	0.010	2.8	0.028
80. Chrysene	Chrysene	0.05	2.8	0.14
81. o-Cresol	p-Cresol	0.010	2.8	0.028
82. p-Cresol	p-Cresol	0.010	2.8	0.028
108. Fluoranthene	Fluoranthene	0.010	2.8	0.028
121. Naphthalene	Naphthalene	0.010	2.8	0.028
141. Phenanthrene	Phenanthrene	0.010	2.8	0.028
142. Phenol	Phenol	0.011	2.8	0.031
145. Pyrene	Pyrene	0.02	2.8	0.056

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The following personnel from Radian Corporation were involved in preparing this document: Mr. John Williams, Program Manager; Ms. Lori Stoll, Project Director; and the Radian engineering team, Ms. Debra Falatko, Ms. Chrisanti Haretos, and Ms. Colleen Kane.

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Appendix A

ACCURACY COR' ECTION OF TREATMENT PERFORMANCE DATA

Appendix A

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

The treatment performance data used to determine treatment standards for K035 were adjusted to account for analytical interferences associated with the chemical matrices of the samples. Generally, treatment performance data were corrected for accuracy as follows: (1) a matrix spike recovery was determined for each BDAT List constituent detected in the untreated or treated waste; (2) an accuracy correction factor was determined for each of the above constituents by dividing 100 by the matrix spike recovery (percent) for that constituent; and (3) treatment performance data for each BDAT List constituent detected in the untreated or treated waste were corrected by multiplying the reported concentration of each constituent by its corresponding accuracy correction factor. The procedure for accuracy correction of the data is described in further detail below.

Matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent.

Matrix spike recoveries used to adjust the treatment performance data transferred to K035 are shown in Tables A-1 and A-2. Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the two values from the first matrix spike and the duplicate spike. An accuracy correction factor of 1 was used when the matrix spike and duplicate matrix spike recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

Where a matrix spike was not performed for an organic constituent, the matrix spike recovery for that constituent was derived from the average matrix spike recoveries of the appropriate group of constituents (e.g., volatile or semivolatile organics) for which recovery data were available. In these cases, the matrix spike recoveries for all volatiles or semivolatiles from the first matrix spike were averaged. Similarly, an average matrix spike recovery was calculated for the duplicate matrix spike recoveries. The lower of the two average matrix spike recoveries of the volatile or semivolatile group was used for any volatile or semivolatile constituent for which no matrix spike was performed.

The accuracy correction factors for the data used to calculate proposed K035 treatment standards are presented in Table A-3. The corrected treatment concentrations for the constituents proposed for regulation in K035 nonwastewaters and wastewaters are presented in Tables A-4 and A-5.

Table A-1

MATRIX SPIKE RECOVERIES FOR KILN ASH RESIDUAL

Spike Constituent	Original Amount Found[a] (ppm)	Amount Spiked (ppm)	Sample Result		Duplicate Sample Result	
			Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Recovered (ppm)	Percent Recovery[b] (%)
VOLATILE ORGANICS						
4. Benzene	ND	0.050	0.050	100	0.049	98
9. Chlorobenzene	ND	0.050	0.053	106	0.053	106
24. 1,1-Dichloroethene	ND	0.050	0.057	114	0.057	114
43. Toluene	ND	0.050	0.053	106	0.052	104
47. Trichloroethene	ND	0.050	0.057	114	0.057	114
SEMIVOLATILE ORGANICS (ACID EXTRACTABLES)						
76. 4-Chloro-3-methylphenol	ND	0.200	0.183	92	0.173	87
78. 2-Chlorophenol	ND	0.200	0.155	78	0.166	83
127. 4-Nitrophenol	ND	0.200	0.074	37	0.069	35
139. Pentachlorophenol	ND	0.200	0.013	7	0.021	11
142. Phenol	ND	0.200	0.153	77	0.159	80
SEMIVOLATILES (BASE/NEUTRAL FRACTION)						
52. Acenaphthene	ND	0.100	0.093	93	0.091	91
88. 1,4-Dichlorobenzene	ND	0.100	0.079	79	0.089	89
102. 2,4-Dinitrotoluene	ND	0.100	0.121	121	0.109	109
105. n-Nitroso-di-n-propylamine	ND	0.100	0.082	82	0.084	84
145. Pyrene	ND	0.100	0.034	34	0.039	39
150. 1,2,4-Trichlorobenzene	ND	0.100	0.084	84	0.089	89

[a]For constituents not quantified in the treatment residual at or above the detection limit (ND), the original amount found is considered zero in calculating percent recovery.

[b]Percent recovery = $100 \times ((C_i - C_o)/C_t)$, where C_o is the concentration of the original amount found, C_i is the concentration of the amount recovered, and C_t is the concentration of the amount spiked.

Source: Onsite Engineering Report for K087 (Reference 6).

Table A-2

MATRIX SPIKE RECOVERIES FOR SCRUBBER WATER RESIDUAL

Spike Constituent	Original Amount Found[a] (ppm)	Amount Spiked (ppm)	Sample Result		Duplicate Sample Result	
			Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Recovered (ppm)	Percent Recovery[b] (%)
VOLATILE ORGANICS						
4. Benzene	ND	0.050	0.053	106	0.054	108
9. Chlorobenzene	ND	0.050	0.056	112	0.053	106
24. 1,1-Dichloroethene	ND	0.050	0.055	110	0.053	106
43. Toluene	ND	0.050	0.065	124	0.065	124
47. Trichloroethene	ND	0.050	0.057	114	0.056	112
SEMIVOLATILE ORGANICS (ACID EXTRACTABLES)						
76. 4-Chloro-3-methylphenol	ND	0.200	0.213	107	0.205	103
78. 2-Chlorophenol	ND	0.200	0.212	106	0.215	108
127. 4-Nitrophenol	ND	0.200	0.233	117	0.236	118
139. Pentachlorophenol	ND	0.200	0.213	107	0.169	85
142. Phenol	ND	0.200	0.192	96	0.186	93
SEMIVOLATILES (BASE/NEUTRAL FRACTION)						
52. Acenaphthene	ND	0.100	0.104	104	0.094	94
88. 1,4-Dichlorobenzene	ND	0.100	0.078	78	0.087	87
102. 2,4-Dinitrotoluene	ND	0.100	0.125	125	0.124	124
105. n-Nitroso-di-n-propylamine	ND	0.100	0.104	104	0.098	98
145. Pyrene	ND	0.100	0.143	143	0.136	136
150. 1,2,4-Trichlorobenzene	ND	0.100	0.077	77	0.085	85

[a]For constituents not quantified in the treatment residual at or above the detection limit (ND), the original amount found is considered zero in calculating percent recovery.

[b]Percent recovery = 100 x $((C_i-C_o)/C_t)$, where C_o is the concentration of the original amount found, C_i is the concentration of the amount recovered, and C_t is the concentration of the amount spiked.

Source: Onsite Engineering Report for K087 (Reference 6)

Table A-3

SUMMARY OF ACCURACY CORRECTION FACTORS

BDAT List Constituent	Accuracy Correction Factor[a]	
	Kiln Ash Residue Total Composition	Scrubber Water Total Composition
4. Benzene	1.02	1.00
34. Methyl ethyl ketone	NA	1.00
43. Toluene	1.00	1.00
215-217. Xylenes (total)	1.00	1.00
51. Acenaphthalene	1.22	1.00
57. Anthracene	1.22	1.00
59. Benz(a)anthracene	1.22	1.00
60. Benzenethiol	1.41	1.00
62. Benzo(a)pyrene	1.22	1.00
63. Benzo(b)fluoranthene	1.22	1.00
65. Benzo(k)fluoranthene	1.22	1.00
80. Chrysene	1.22	1.00
82. p-Cresol	1.41	1.00
108. Fluoranthene	1.22	1.00
109. Fluorene	1.22	1.00
116. Indeno(1,2,3-cd)pyrene	1.22	1.00
121. Naphthalene	1.22	1.00
141. Phenanthrene	1.22	1.00
142. Phenol	1.30	1.08
145. Pyrene	2.94	1.00

[a]The accuracy correction factor is equal to 100 divided by the percent recovery. An accuracy correction factor of 1 was used when matrix spike and duplicate matrix spike recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

NA - Not applicable.

Table A-4

ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS
FOR CONSTITUENTS PROPOSED FOR REGULATION IN K035 NONWASTEWATERS

BDAT List Constituent	Sample Set:	Concentration[a] Corrected Total in K087 Incinerator Ash (ppm)				
		1	2	3	4	5
VOLATILE ORGANICS						
4. Benzene		0.0255	0.0255	0.0255	0.0255	0.0255
43. Toluene		0.150	0.085	0.025	0.025	0.190
215-217. Xylenes (total)		0.025	0.025	0.025	0.025	0.025
SEMIVOLATILE ORGANICS						
51. Acenaphthalene		1.22	1.22	1.22	1.22	1.22
57. Anthracene		1.22	1.22	1.22	1.22	1.22
59. Benz(a)anthracene		1.22	1.22	1.22	1.22	1.22
60. Benzenethiol		140.8	140.8	140.8	140.8	140.8
62. Benzo(a)pyrene		1.22	1.22	1.22	1.22	1.22
63. Benzo(b)fluoranthene		1.22	1.22	1.22	1.22	1.22
65. Benzo(k)fluoranthene		1.22	1.22	1.22	1.22	1.22
80. Chrysene		1.22	1.22	1.22	1.22	1.22
82. p-Cresol		1.41	1.41	1.41	1.41	1.41
108. Fluoranthene		1.22	1.22	1.22	1.22	1.22
109. Fluorene		1.22	1.22	1.22	1.22	1.22
116. Indeno(1,2,3-cd)pyrene		1.22	1.22	1.22	1.22	1.22
121. Naphthalene		1.22	1.22	1.22	1.22	1.22
141. Phenanthrene		1.22	1.22	1.22	1.22	1.22
142. Phenol		1.30	1.30	1.30	1.30	1.30
145. Pyrene		2.94	2.94	2.94	2.94	2.94

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.

Table A-5

ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS
FOR CONSTITUENTS PROPOSED FOR REGULATION IN K035 WASTEWATERS

	Corrected Total Concentration[a] in K087 Scrubber Water (ppm)				
Sample Set:	1	2	3	4	5
BDAT List Constituent					
VOLATILE ORGANICS					
4. Benzene	0.005	0.005	0.005	0.005	0.005
34. Methyl ethyl ketone	0.014	0.010	0.010	0.010	0.010
43. Toluene	0.005	0.008	0.005	0.005	0.005
215-217. Xylenes (total)	0.005	0.005	0.005	0.005	0.005
SEMIVOLATILE ORGANICS					
51. Acenaphthalene	0.010	0.010	0.010	0.010	0.010
57. Anthracene	0.010	0.010	0.010	0.010	0.010
59. Benz(a)anthracene	0.010	0.010	0.010	0.010	0.010
60. Benzenethiol	1.00	1.00	1.00	1.00	1.00
62. Benzo(a)pyrene	0.010	0.010	0.010	0.010	0.010
63. Benzo(b)fluoranthene	0.010	0.010	0.010	0.010	0.010
65. Benzo(k)fluoranthene	0.010	0.010	0.010	0.010	0.010
80. Chrysene	0.050	0.050	0.050	0.050	0.050
82. p-Cresol	0.010	0.010	0.010	0.010	0.010
108. Fluoranthene	0.010	0.010	0.010	0.010	0.010
109. Fluorene	0.010	0.010	0.010	0.010	0.010
116. Indeno(1,2,3-cd)pyrene	0.010	0.010	0.010	0.010	0.010
121. Naphthalene	0.010	0.010	0.010	0.010	0.010
141. Phenanthrene	0.010	0.010	0.010	0.010	0.010
142. Phenol	0.011	0.011	0.011	0.011	0.011
145. Pyrene	0.020	0.020	0.020	0.020	0.020

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.